SYSTEM AND METHOD FOR THE TRANSMISSION OF MESSAGE TRAFFIC

FIELD OF THE INVENTION

The present invention relates to telecommunication. In particular, the invention relates to a new and advanced method and system for the transmission of message traffic in the network elements of packet-switched telecommunication systems.

BACKGROUND OF THE INVENTION

At present, several methods for the transmission of the message traffic between the unit computers of the network elements of packet-switched telecommunication systems are known. For the implementation of the packet-switched telecommunication system itself, one method is to use the ATM technique (Asynchronous Transfer Mode, ATM). Another example of packet-switched methods is the Frame Relay technique.

ATM is a connection oriented packet-switched data transfer method which is characterized by the use of standard-length cells for data transfer. Each cell consists of a 5-byte header and a 48-byte information part. The header fields comprise a virtual path identifier (VPI) and a virtual channel identifier (VCI), a payload type identifier (PTI), a cell loss priority bit (CLP) and a header error control (HEC) which can be used to correct one-bit errors and to detect two-bit errors. In an ATM switch, the cells are transferred from a logical input channel to one or more logical output channels. A logical channel consists of the number of the physical link, such as e.g. an optic fiber, and the identifier of the channel in this link, i.e. the VPI/VCI data. A single physical transmission medium, such as an optic fiber, may contain a plurality of virtual paths VP, and each virtual path may contain a plurality of virtual channels VC.

Since the cells have a standard length, the switching in the ATM switches can be performed on the basis of the cell header at hardware level and therefore very fast. Cells belonging to different connec-
5   tions are distinguished from each other by the virtual path and virtual channel identifiers. To set up a connection over the network, a fixed route, i.e. a virtual link is defined, and the cells comprised in the connection are routed along this virtual link. In the
10   nodes of the network, the cells are connected on the basis of the VPI/VCI values. The VPI/VCI values of the cells are defined separately for each leg of the connection, so they generally change in conjunction with the connection of VP-level or VC-level. At the end of
15   the data transfer, the link is disconnected.

The ATM protocol is described using an ATM protocol model, which is a layered model resembling the OSI (Open Standards Interconnection) model. The topmost level in the model is the data coming from the
20   user. The next layer below it is an ATM adaptation layer (AAL). Below that is again an ATM layer, below which there is further a physical layer (PHY). The AAL layer is divided into two parts, a SAR layer (Segmentation And Reassembly) and a CS layer (Convergence
25   Sublayer). The CS layer is further divided into two sublayers: SSCS layer (Service Specific Convergence Sublayer) and CPCS layer (Common Part Convergence Sublayer).

The ATM adaptation layer divides the frames
30   of the layers above it into pieces, places the pieces into cells and reassembles the frames at the receiving end.

The ATM layer again offers a cell transfer service to the AAL layer. It only deals with the cell
35   header, taking care of the connection, multiplexing and demultiplexing of cells, generation and deletion of cell header, and generic flow control (GFC) at the

user network interface (UNI). In addition, the ATM layer takes care of detection and correction of header errors as well as segment synchronization.

The physical layer is also divided into two
5 sublayers, a PMD (Physical Medium Dependent) sublayer, which takes care of transfer-system specific functions at bit level; and a transmission convergence sublayer (TCS), which takes care of adaptation of cells to each transmission system and definition of cells, error
10 checks on cell headers and cell rate adjustment.

A network element consists of a cross-connection part, which takes care of actual cross-connection of data, and a control part, which performs various control actions. Typically, both the cross-
15 connection part and the control part comprise several unit computers. Message traffic flows between these unit computers.

Fig. 1 presents a prior-art solution for the transmission of message traffic between unit computers
20 in the network elements of packet-switched telecommunication systems. The message traffic between the unit computers C_k of the control part is transmitted via a separate higher-capacity path and the message traffic e.g. for the setup of cross-connections between the
25 unit computers C_r of the cross-connection part and the unit computers C_k of the control part is transmitted via a separate lower-capacity path. In the figure, the dotted line represents a message traffic connection.

Another prior-art solution is presented in
30 Fig. 2. The message traffic between the unit computers C_k of the control part has been routed via the network element's own cross-connections. However, the message traffic between the unit computers C_r of the cross-connection part and the unit computers C_k of the con-
35 trol part still flows via a separate path.

Fig. 3 also presents a prior-art implementation. In this case, the cross-connection is not a uni-

versal connection. An example of this type of different cross-connection is to transmit, in systems based on the ATM technique, so-called in-band control cells which flow along with the rest of the traffic and which are removed from the cell flow by the target circuit. Another example of different cross-connection is an implementation in which a unit computer is placed directly on the plug-in unit of the second terminal point of the cross-connection.

However, such solutions have the drawback of poor scalability. The improve the scalability of the message traffic system, projects have been started to develop systems e.g. in ATM networks in which the ATM switch itself is used for the transmission of message traffic, in which case message traffic would be carried in the subscriber traffic flow. In such a system, e.g. in the case of ATM, the computer units are connected to the ATM switching fabric either directly via a separate line card or via an ATM multiplexer. The unit computers of the line cards, i.e. plug-in units, are connected to the ATM switching fabric via the ATM circuits on the cards to allow the transmission of message traffic. This is the fundamental principle behind e.g. the system described in an article entitled The MainStreetXpress Core Services Node - A Versatile ATM Switch Architecture for the Full Service Network, published in IEEE Journal on Selected Areas in Communications, Vol. 15, No. 5, June 1997.

A problem in the prior-art systems is that they are dependent on circuit-specific properties, such as, e.g. in the case of ATM, the cell insertion and deletion functions of the ATM circuit. As a consequence, each plug-in unit type needs a specific type of SAR (Segmentation And Reassembly) interface for connection to the ATM circuits in the plug-in unit in question. A further problem is that the transmission

of both subscriber traffic and message traffic via the
same lines is difficult to manage.

5   The object of the invention is to disclose a
new type of system and method that will eliminate the
problems referred to above. A specific object of the
invention is to disclose a flexible and optimal system
and method for the transmission of message traffic in
packet-switched telecommunication systems.

10   **BRIEF DESCRIPTION OF THE INVENTION**

In the present invention, internal message
traffic within a network element is transmitted be-
tween the unit computers of the cross-connection part
of the network element and/or the unit computers of
15   the control part in a packet-switched telecommunica-
tion system, said system comprising a network element,
which again comprises a cross-connection part compris-
ing at least one unit computer. In this context, 'net-
work element' means e.g. a telephone switching center
20   implemented utilizing the ATM technique. In addition,
the network element comprises a control part which
comprises at least one unit computer. According to the
invention, the system comprises in the cross-
connection part at least one unit computer whose mes-
25   sage traffic is transmitted by utilizing the universal
cross-connections produced by the network element it-
self. In addition, this unit computer of the cross-
connection part is disposed on a plug-in unit other
than the plug-in unit on which is disposed the nearest
30   terminal point of the cross-connection used by the
said unit computer for the transmission of message
traffic. In practice, both the cross-connection part
and the control part are often disposed on several
plug-in units. Thus, the invention allows a situation
35   where the above-mentioned unit computer of the cross-
connection part and the nearest terminal point of the
cross-connection used are on different plug-in units.

Direct communication between unit computers on the same plug-in unit is previously known.

In an embodiment of the invention, the system comprises at least one control part unit computer whose message traffic is transmitted by utilizing the universal cross-connections produced by the network element itself.

In an embodiment of the invention, the functions of the control part are distributed among the plug-in units of the cross-connection part. In this case, too, the communication by the cross-connection part can be regarded as being implemented as described above.

In an embodiment of the invention, the telecommunication system is a communication system based on the ATM technique (Asynchronous Transfer Mode, ATM).

In an embodiment of the invention, the cross-connection part comprises one or more computer units, each comprising a SAR-PHY circuit pair (Segmentation And Reassembly, SAR; Physical Layer, PHY) and a unit computer. The SAR circuit is a circuit which performs at least some of the functions defined for the SAR sublayer comprised in the ATM protocol model, said functions comprising e.g. the segmentation of user data coming from a higher layer into segments that, when transferred to a lower layer, fit into the payload fields of successive ATM cells. In addition, these functions include the reassembly of segmented data coming from lower layers for transfer to higher layers.

Similarly, the PHY circuit (physical layer circuit) is a circuit which performs at least some of the functions defined for the physical layer, including e.g. transfer system-specific bit-level functions and taking care of the adaptation of cells to each transfer system as well as the definition of cells,

error checks on cell headers and adjustment of cell rate. The SAR-PHY circuit pair consists of a SAR circuit and a PHY circuit.

5   In an embodiment of the invention, the cross-connection part comprises one or more LIU units (Line Interface Unit, LIU), each of which comprises a unit computer, a SAR-PHY circuit pair, a PHY circuit and an ATM circuit (ATM layer circuit). The LIU unit is e.g. a line card provided with a plurality of lower-speed

10   interfaces, such as e.g. prior-art T1, J1 and/or J2 interfaces. Naturally, the interfaces may also be higher-speed types, such as e.g. prior-art STM-1 or E1 interfaces, but in this application such interfaces may not allow the best possible utilization of capac-

15   ity. The ATM circuit again is a circuit which performs at least some of the functions defined for the ATM layer, including e.g. the multiplexing and connection of cells, provision of virtual connections between terminal points and maintenance of an agreed level of

20   quality of service (QOS).

In an embodiment of the invention, the cross-connection part comprises an ATM switching fabric (ASF), which comprises a unit computer, a SAR-PHY circuit pair and an ATM circuit. As indicated by its

25   name, the ATM switching fabric takes care of switching functions.

As compared with prior art, the present invention has the advantage of being independent of circuit-specific properties, such as e.g. the properties

30   of ATM circuits. As the SAR circuits e.g. in the case of ATM are not directly connected to any ATM circuit, there is no need to adapt them according to individual properties of ATM circuits. Thus, the invention makes it possible to use conventional universal ATM inter-

35   faces. According to the invention, each computer unit (or unit computer) can send messages simultaneously to different unit computers. Accordingly, the same advan-

tages are also achieved in the case of other packet-switched systems, such as e.g. the Frame Relay system. A further advantage of the invention is a good scalability.

LIST OF ILLUSTRATIONS

In the following, the invention will be described in detail by the aid of a few examples of its embodiments with reference to the attached drawing, wherein

Fig. 1 presents a prior-art system;

Fig. 2 presents a prior-art system;

Fig. 3 presents a prior-art system;

Fig. 4 presents a block diagram representing a system according to the invention;

Fig. 5 presents a block diagram representing a system according to the invention, implemented using the ATM technique; and

Fig. 6 presents a flow diagram representing a method according to the invention.

DETAILED DESCRIPTION OF THE INVENTION

Fig. 4 presents an example showing the components of a system according to the invention. The system comprises a network element 1, which comprises a cross-connection part 11, which comprises at least one unit computer C_r. In addition, the network element 1 comprises a control part 12, which comprises at least one unit computer C_k. According to the invention, the system comprises at least one unit computer C_r in the cross-connection part 11 whose message traffic is transmitted by utilizing universal cross-connections produced by the network element 1 itself. This cross-connection part unit computer C_r is disposed on a different plug-in unit than the nearest terminal point of the cross-connection used by it for message traffic.

In practice, both the cross-connection part and the
control part are often disposed on several plug-in
units (not shown in the figure). Thus, the invention
allows a situation where the cross-connection part
5   unit computer C_k in question and the nearest terminal
point of the cross-connection used are disposed on
different plug-in units. In Fig. 4 presents an example
in which the terminal points of a cross-connection be-
ing used are indicated by "X", the nearest terminal
10   point being naturally that terminal point which is
closer to the said cross-connection part unit computer
C_r. In a preferred case, the message traffic of all
the unit computers C_r of the cross-connection part 11
is transmitted in the manner described above, although
15   this is not absolutely necessary.

Fig. 5 presents an example of a system ac-
cording to the invention, implemented using ATM based
components. However, the system of the invention is in
no way tied to the ATM technique; instead, it can be
20   applied to any other packet-switched system, such as
e.g. systems based on the Frame Relay technique. The
implementation presented in Fig. 5 is only an example
of how the system of the invention can be implemented
using the ATM technique. There are also many other
25   possibilities to implement the system of the invention
using ATM. The system comprises a network element 2,
which comprises a cross-connection part 21 and a con-
trol part 22. The control part 22 comprises a number
of computer units CU, each of which comprises a SAR-
30   PHY circuit pair P/S and a unit computer C. The func-
tions of the computer units CU may include e.g. con-
trol of the switching fabric, taking care of input and
output side signalling and monitoring, collection of
call-specific billing data, collection of statistics
35   and/or execution of traffic measurements. In practice,
the computer unit CU may be e.g. an operations and
maintenance unit (OMU). The cross-connection part 21

comprises one or more LIU units LIU and a ATM switch-
ing fabric ASF. Each LIU unit LIU comprises a unit
computer C, a SAR-PHY circuit pair S/P, a PHY circuit
P and an ATM circuit A. The ATM switching fabric ASF
5   again comprises a unit computer C, a SAR-PHY circuit
pair S/P and an ATM circuit A. Thus, the SAR-PHY cir-
cuit pair and the conductor together form a universal
ATM interface.

        Thus, in the system of the invention, e.g. an
10 ATM switch is used for making the connections for mes-
sage traffic between the computer units and the unit
computers of the plug-in units. However, message traf-
fic connections are just normal cross-connections as
are made for subscriber traffic as well. Therefore,
15 the operation of the system of the invention is com-
pletely independent of the properties of the ATM cir-
cuits, because the SAR circuits are not directly con-
nected to any ATM circuit.

        Fig. 6 presents a flow diagram representing a
20 method according to the invention. In step 31, a uni-
versal cross-connection is established. In step 32,
message traffic is transmitted from a sending unit
computer, the cross-connection part unit computer in
question being disposed on a different plug-in unit
25 than the nearest terminal point of the cross-
connection it is using for message traffic. Next, in
step 33, the message traffic is transmitted to the re-
ceiving unit computer. Finally, in step 34, the cross-
connection is disconnected.

30   The invention is not restricted to the exam-
ples of its embodiments described above; instead, many
variations are possible within the scope of the inven-
tive idea defined in the claims.